



Vivekanand Education Society's
College of Arts, Science & Commerce
(Autonomous)

Syllabus

For the

Program: T.Y.B.Sc. Sem - V & VI

CBCS Course: Computer Science

(Choice Based and Credit System with effect
from the academic year 2023-24)

Sr. No.	Heading	Particulars
1.	Title of the Course	T.Y.B.Sc. Sem. V & VI (Computer Science)
2.	Eligibility for Admission	Ordinance no. O.5719 Circular no. UG/284 of 2007 dated 16 th June 2007
3.	Passing Marks	40%
4.	Ordinances / Regulations (if, any)	As applicable for all B.Sc. Courses
5.	Number of years / Semesters	Three years – Six Semesters
6.	Level	P.G./ U.G. / Diploma / Certificate (Strike out which is not applicable)
7.	Pattern	Yearly / Semester, Choice Based (Strike out which is not applicable)
8.	Status	New / Revised
9.	To be implemented from Academic year	From the Academic Year 2023 – 2024

V.E.S.

Since 1962

Preamble

The rise of Information and Communication Technology (ICT) has profoundly affected modern society. Increasing applications of computers in almost all areas of human endeavor has led to vibrant industries with concurrent rapid change in technology.

As the computing field advances at a rapid pace, the students must possess a solid foundation that allows and encourages them to maintain relevant skills as the field evolves. Specific languages and technology platforms change over time. Thus students must continue to learn and adapt their skills throughout their careers. To develop this ability, students will be exposed to multiple programming languages, tools, paradigms and technologies as well as the fundamental underlying principles throughout this programme.

The programme offers required courses such as programming languages, data structures, computer architecture, algorithms, database systems, operating systems, software engineering; as well as specialized courses like artificial intelligence, machine learning, internet of things, distributed computing, information security, multimedia, web technologies, mobile programming and other current topics in computer science.

The core philosophy of this programme is to –

- Form strong foundations of Computer Science
- Nurture programming, analytical & design skills for the real world problems.
- Inculcate research interest among the students
- Introduce emerging trends to the students in a gradual way.
- Groom the students for the challenges of ICT industry

The main aim of this programme is to deliver a modern curriculum that will equip graduates with strong theoretical and practical backgrounds to enable them to excel in the workplace and to be lifelong learners. Not only does it prepare the students for a career in the Software industry, it also motivates them towards further studies and research opportunities. Graduating students can thus take up postgraduate programmes in CS leading to research as well as R&D, can be employable at IT industries, or can adopt a business management career.

In the first year i.e. for semester I & II, the basic foundation of important skills required for software development is laid. The syllabus proposes to have four core subjects of Computer science and two core courses of Mathematics-Statistics. All core subjects are proposed to have theory as well as practical tracks. While the Computer Science courses will form fundamental skills for solving computational problems, the Mathematics & Statistics course will inculcate research-oriented acumen. Ability Enhancement Courses on Soft Skill Development will ensure an overall and holistic development of the students. The syllabus design for further semesters encompasses more advanced and specialized courses of Computer Science.

We sincerely believe that any student taking this programme will get a strong foundation and exposure to basics, advanced and emerging trends of the various subjects discussed. We hope that the students' community and teachers fraternity will appreciate the treatment given to the courses in the syllabus. We wholeheartedly thank all the experts who shared their valuable feedback and suggestions in order to improve the contents; we have sincerely attempted to incorporate each of them.

Programme Structure for B.Sc. Computer Science

Programme Duration	06 Semesters <i>spread across 3 years</i>
Total Credits required for successful completion of the Course	120
Credits required from the Core Courses	76
Credits required for the Ability Enhancement Courses	04
Credits required for Skills Enhancement Courses	32
Credits for General Elective Courses	08
Minimum Attendance per Semester	75%

Programme Objectives

The objectives of the 3 year B.Sc. Computer Science programme are as follows:

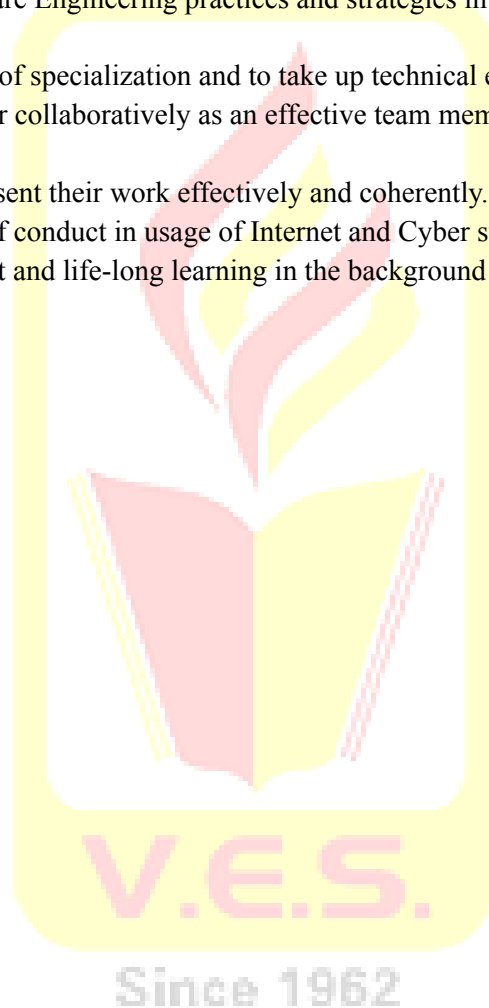
- To develop an understanding and knowledge of the basic theory of Computer Science with a strong foundation on theory, systems and applications.
- To refine necessary skills and analytical abilities for developing computer based solutions of real-life problems.
- To provide training in emergent computing technologies which lead to innovative solutions for industry and academia.
- To develop the necessary study skills and knowledge to pursue further postgraduate study in computer science or other related fields.
- To develop the professional skill-set required for a career in technology oriented business or industry.
- To enable students to work independently and collaboratively, communicate effectively, and become responsible, competent, confident, insightful, and creative users of computing technology

Since 1962

Programme Learning Outcomes

At the end of three year Bachelor of Computer Science the students will be able:

- To formulate, to model, to design solutions, procedure and to use software tools to solve real world problems.
- To design and develop computer programs/computer -based systems in the areas such as networking, web design, security, cloud computing, IoT, data science and other emerging technologies.
- To familiarize with the modern-day trends in industry and research based settings and thereby innovate novel solutions to existing problems.
- To apply concepts, principles, and theories relating to computer science to new situations. To use current techniques, skills, and tools necessary for computing practice
- To apply standard Software Engineering practices and strategies in real-time software project development
- To pursue higher studies of specialization and to take up technical employment.
- To work independently or collaboratively as an effective team member on a substantial software project.
- To communicate and present their work effectively and coherently.
- To display ethical code of conduct in usage of Internet and Cyber systems.
- To engage in independent and life-long learning in the background of the rapidly changing IT industry.



Academic year 2023-2024

Semester – V				
Course Code	Course Type	Course Title	Credits	Lectures/Week
		Elective I (Select any 2)		
VESUCS501	Core Subject	Data Science	3	3
VESUCS502	Core Subject Practical	Linux Server Administration	3	3
VESUCS503	Core Subject	Introduction to Business Intelligence, Data Warehousing and Data Mining	3	3
VESUCSP501	Elective-1 Practical	Practical Of Elective-I	2	6
		Elective II (Select any 2)		
VESUCS504	Core Subject	Information and Network Security	3	3
VESUCS505	Core Subject	Architecting of IoT	3	3
VESUCS506	Core Subject	Web Services	3	3
VESUCSP502	Elective-2 Practical	Practical Of Elective-II	2	6
		Skill Enhancement		
VESUCS507	Skill Enhancement	Game Programming	2	3
VESUCSP503	Skill Enhancement- Practical	Game Programming Practical	1	3
		Ability Enhancement		
VESUCSP504	Ability Enhancement- Practical	Project Implementation	1	3

Semester – VI				
Course Code	Course Type	Course Title	Credits	Lectures/Week
		Elective I (Select any 2)		
VESUCS601	Core Subject	Wireless Sensor Networks and Mobile Communication	3	3
VESUCS602	Core Subject Practical	Cloud Computing	3	3
VESUCS603	Core Subject	Blockchain Technology	3	3
VESUCSP601	Elective-1 Practical	Practical Of Elective-I	2	6
		Elective II (Select any 2)		
VESUCS604	Core Subject	Information Retrieval	3	3
VESUCS605	Core Subject	Digital Image Processing	3	3
VESUCS606	Core Subject	Artificial Intelligence	3	3
VESUCSP602	Elective-2 Practical	Practical Of Elective-II	2	6
		Skill Enhancement		
VESUCS607	Skill Enhancement	Ethical Hacking	2	3
VESUCSP603	Skill Enhancement- Practical	Ethical Hacking-Practical	1	3
		Ability Enhancement		
VESUCSP604	Ability Enhancement- Practical	Project Implementation	1	3

Semester – 5

Course Code	Course Title	Credits	Lectures / Week
VESUCS501	Data Science	2	3
About the course: The course will introduce the basic concepts of data science & various machine learning models			
Course Objectives: <ul style="list-style-type: none"> • To cover basic concepts of data science • To cover important data preprocessing activities • To cover aspects of how to analyze data using statistical techniques • To introduce various machine learning techniques 			
Learning Outcomes: Learners will be able to - <ul style="list-style-type: none"> • Read data from various data sources • Convert data into suitable formats for processing • Perform analysis and apply various machine learning models based on type of problem • Evaluate the model • Draw insights and present in the right format to the right audience. 			
Unit	Topic	No. of lectures	
I	Introduction to Data Science - What is Data Science, Concepts, Process and tools/technologies used for Data Science, Data Science as compared to other fields like BI, AI, ML, DW-DM, Applications of Data Science, Various roles in data science, What is Data, Different kinds of data, Types of Data, Data Sources, Data Preprocessing - Data Cleaning, Transforming, Selecting columns/fields, Merging data, Handling missing values, outliers, Data aggregation Data Wrangling, Feature Engineering & its types, Dummmification, Feature Scaling, Use of popular libraries like - Pandas, Numpy, Sci-kit Learn, etc or technology specific libraries	15	

II	<p>Data Analysis - Exploratory Data Analysis (EDA), Types of Data analysis, Tools used for data analysis, Techniques to analyze data like Hypothesis Testing, ANOVA</p> <p>Machine Learning : What is machine learning, Types of machine learning, Supervised, Unsupervised Methods, Classification, Clustering, Bias variance Tradeoff, Underfitting, Overfitting,</p> <p>Regression and its types(Simple, Multiple, Stepwise, Logistic), Cross-Validation, Issues like multicollinearity, heteroscedasticity,</p> <p>Techniques like Decision Tree , K-Means, PCA</p>	15
III	<p>Model Selection and Model Evaluation - Model Evaluation and its techniques like accuracy, confusion matrix, f-score, AUC for various machine learning techniques</p> <p>Data Visualization & Communication - What is data visualization, types of data visualization, Benefits, Visualization Tools, Data Storytelling</p> <p>Data Management - Introduction, Activities under data management, Data Pipeline</p>	15

TextBooks :

- 1) Data Science from Scratch First Principles with Python- Joel Grus O'reilly, 2nd Edition
- 2) Advancing into Analytics From Excel to Python and R, George Mount, Oreilly, First Edition
- 3) Introduction to Machine Learning with Python, Andreas C. Muller, Sarah Guido, Oreilly, First Edition

Additional References:

- 1) Doing Data Science, Rachel Schutt and Cathy O'Neil, O'Reilly, 2013
- 2) Mastering Machine Learning with R, Cory Lesmeister, PACKT Publication, 2015
- 3) Hands-On Programming with R, Garrett Golemund, 1st Edition, 2014
- 4) An Introduction to Statistical Learning, James, G., Witten, D., Hastie, T., Tibshirani, R., Springer, 2015

Course Code	Course Title	Credits	Practical/ Tutorials Per Week
VESUCSP 501	Data Science (Using various softwares like R/Python/Google Colab/Tableau)	1	3
1	Introduction to Excel and various functions like conditional formatting, pivot tables, vlookup, what-if analysis, lookup functions, goal-seek, charts etc		
2	Creating data frames from various types of files(csv/json etc) and performing various basic data pre-processing functions		
3	Practical on feature scaling & Feature Dummification		
4	Practical on Hypothesis Testing		
5	Practical on ANOVA		

6	Practical on Regression & its types
7	Practical on Logistic Regression & Decision Tree
8	Practical on K-Means
9	Practical on PCA
10	Practical on Data Visualization and Storytelling

Course Code	Course Title	Credits	Lectures / Week
VESUCS502	Linux Server Administration	2	3
<p>About the course: This course introduces the concepts of administration on linux server with various settings need to be done to set up various types of services in an effective way.</p>			
<p>Course Objectives: The objectives of the course are -</p> <ul style="list-style-type: none"> • Demonstrate proficiency with the Linux command line interface, directory & file management techniques, file system organization, and tools commonly found on most Linux distributions. • Effectively operate a Linux system inside of a network environment to integrate with existing service solutions. • Demonstrate the ability to troubleshoot challenging technical problems typically encountered when operating and administering Linux systems. 			
<p>Learning Outcomes: Learner will be able to -</p> <ul style="list-style-type: none"> • Develop Linux based systems and maintain. • Install appropriate service on Linux server as per requirement. • Develop proficiency in Linux server administration. 			
Unit	Topic	No. of lectures	

<p style="text-align: center;">I</p>	<p>Introduction:</p> <p>Technical Summary of Linux Distributions, Managing Software</p> <p>Single-Host Administration:</p> <p>Managing Users and Groups, Booting and shutting down processes, File Systems, Core System Services, Process of configuring, compiling, Linux Kernel</p> <p>Networking and Security:</p> <p>TCP/IP for System Administrators, basic network Configuration, Linux Firewall(Netfilter), System and network security</p>	<p>15</p>
<p style="text-align: center;">II</p>	<p>Internet Services:</p> <p>Domain Name System (DNS), File Transfer Protocol (FTP), Apache web server, Simple Mail Transfer Protocol (SMTP), Post Office Protocol and Internet Mail Access Protocol (POP and IMAP), Secure Shell (SSH), Network Authentication, OpenLDAP Server, Samba and LDAP, Network authentication system(Kerberos), Domain Name Service (DNS), Security</p>	<p>15</p>
<p style="text-align: center;">III</p>	<p>Intranet Services:</p> <p>Network File System (NFS), Samba, Distributed File Systems (DFS), Network Information Service (NIS), Lightweight Directory Access Protocol (LDAP), Dynamic Host Configuration Protocol (DHCP), MySQL, LAMP Applications File Servers, Email Services, Chat Applications, Virtual Private Networking.</p>	<p>15</p>
<p>TextBooks :</p> <ol style="list-style-type: none"> 1) Linux Administration: A Beginner's Guide, Wale Soyinka, Seventh Edition, McGraw-Hill Education, 2016 2) Ubuntu Server Guide, Ubuntu Documentation Team, 2016 <p>Additional References:</p> <ol style="list-style-type: none"> 1) Mastering Ubuntu Server, Jay LaCroix, PACKT Publisher, 2016 		

Course Code	Course Title	Credits	Practical/ Tutorials Per Week
VESUCS P501	Linux Server Administration Practical	1	3
1	Install DHCP Server in Ubuntu 16.04		
2	Initial settings: Add a User, Network Settings, Change to static IP address, Disable IPv6 if not needed, Configure Services, display the list of services which are running, Stop and turn OFF auto-start setting for a service if you don't need it, Sudo Settings		
3	Configure NTP Server (NTPd), Install and Configure NTPd, Configure NTP Client (Ubuntu and Windows)		
4	SSH Server : Password Authentication Configure SSH Server to manage a server from the remote computer, SSH Client : (Ubuntu and Windows)		
5	Install DNS Server BIND, Configure DNS server which resolves domain name or IP address, Install BIND 9, Configure BIND, Limit ranges you allow to access if needed.		
6	Configure DHCP Server, Configure DHCP (Dynamic Host Configuration Protocol) Server, Configure NFS Server to share directories on your Network, Configure NFS Client. (Ubuntu and Windows Client OS)		
7	Configure LDAP Server, Configure LDAP Server in order to share users' accounts in your local networks, Add LDAP User Accounts in the OpenLDAP Server, Configure LDAP Client in order to share users' accounts in your local networks. Install phpLDAPadmin to operate LDAP server via Web browser.		
8	Configure NIS Server in order to share users' accounts in your local networks, Configure NIS Client to bind NIS Server.		
9	Install MySQL to configure database server, Install phpMyAdmin to operate MySQL on web browser from Clients.		
10	Install Samba to share folders or files between Windows and Linux.		

- Practical shall be performed using any Linux Server (with 8GB RAM).

Internet connection will be required so that Linux server (command line mode) can be connected to the Internet.

Course Code	Course Title	Credits	Lectures / Week
VESUCS503	Introduction to Business Intelligence, Data Warehousing and Data Mining	2	3

About the course:

Data warehousing and data mining allow organizations to collect, store, and analyze large amounts of data from various sources. This can provide valuable insights and information that can be used to improve business processes, make better decisions, and gain a competitive advantage.

Course Objectives:

1. The concepts and techniques of data warehousing, including data cleaning, data integration, and data consolidation.
2. The process of data mining, including the use of algorithms and statistical methods to extract useful information from large sets of data.
3. The use of data mining tools and techniques to identify patterns, trends, and relationships in data

Learning Outcomes:

- 1.Improved data accessibility and organization
2. Data warehousing allows for the centralization and consolidation of data from multiple sources, making it easier for users to access and analyze the information they need.
- 3.Increased efficiency and automation of business processes: Data mining can be used to uncover patterns and insights in the data, which can then be used to automate and streamline business processes.
- 4.Better decision-making: With access to more complete and accurate data, organizations can make more informed decisions.

Unit	Topic	No. of lectures
I	Data-Information-Knowledge-Decision making-Action cycle. Business Intelligence; Data warehousing, Business Intelligence architecture, Use and benefits of Business Intelligence. Knowledge Discovery in Databases: KDD process model, Data Pre-processing: Cleaning: Missing Values; Noisy Values; Inconsistent values; redundant values. Outliers, Integration, transformation, reduction, Discretization: Equal Width Binning; Equal Depth, Binning, Normalization, Smoothing	15
II	Introduction to data warehousing and concepts, definitions, and applications, Definition of Data warehouse, Logical architecture of Data Warehouse, Data Warehouse model- Enterprise warehouse; Data Marts; Virtual warehouse.	15

	Data warehousing architecture and design: dimensional modeling, star schema, snowflake schema, and data marts, Data warehousing tools and technologies: ETL (Extract, Transform, Load) tools. Data warehousing platforms.	
III	<p>Data pre-processing: Principles of dimensional modeling, Data cubes, Data cube operations, data cube schemas.</p> <p>Data cleaning, data integration, data transformation, and data reduction. Designing Business Data Warehouse: Table Characteristics; OLAP Cube, OLAP Operations, OLAP Server Architecture-ROLAP, MOLAP and HOLAP. Data Lake.</p> <p>Data mining techniques: association rule mining, clustering, classification, and prediction, Big data analytics tools, Importance of data governance, security, and privacy in data warehousing and data mining with big data.</p>	15
<p>Textbooks: References:</p> <ol style="list-style-type: none"> 1. Building the Data Warehouse, Inmon: Wiley (1993). 2. Data Mining: Introductory and Advanced Topics, Dunham, Margaret H, Prentice Hall (2006) 3. Data Mining: Practical Machine Learning Tools and Techniques, Second Edition, Witten, Ian and Eibe Frank, Morgan Kaufmann (2011) 4. Data Mining: Concepts and Techniques, The Morgan Kaufmann Series in Data Management Systems, Han J. and Kamber M. Morgan Kaufmann Publishers, (2000). <p>Additional References:</p> <ol style="list-style-type: none"> 1. Business Intelligence (2nd Edition), Efraim Turban, Ramesh Sharda, Dursun Delen, David King, Pearson (2013) 2. Business Intelligence for Dummies, Swain Scheps, Wiley Publications (2008). 3. Business Intelligence RoadMap, Larissa T. Moss, Shaku Atr, Addison-Wesley 4. Data Modeling Techniques for Data Warehousing by IBM; International Technical Support Organization, Chuck Ballard, Dirk Herreman, Don Schau, Rhonda Bell, Eunsang Kim, 		

Course Code	Course Title	Credits	Practical/Tutorials Per Week
VESUCS P501	Introduction to Business Intelligence, Data Warehousing and Data Mining using various tools like Apache Airflow/Python's Libraries/Weka/Tableau/PowerBI	1	3
1	Create tables using different applications.		
2	Develop an application to design a warehouse by importing various tables from external sources.		
3	Execute a code for implementing ETL in Python.(Apache Airflow/PETL-Python's ETL Library)		
4	Execute the code to generate a data warehouse(Apache Airflow		
5	Implementation of OLAP using Python.		
6	Implementation to perform data mining using WEKA and Python separately.		
7	Develop an application to pre-process data imported from external sources.		
8	Build a BI report using various tables created in the warehouse on Tableau Public/PowerBI		
9	Execute a wordcount problem using Spark and NLTK		

Course Code	Course Title	Credits	Lectures / Week
VESUCS 504	Information and Network Security	2	3
<p>About the course: Information and Network Security introduce encryption decryption techniques.introduces about authentication process variety of security threats and vulnerabilities.</p>			
<p>Course Objectives: To provide students with knowledge of basic concepts of computer security including network security and cryptography.</p>			
<p>Learning Outcomes: Understand the principles and practices of cryptographic techniques. Understand a variety of generic security threats and vulnerabilities, and identify & analyze particular security problems for a given application. Understand various protocols for network security to protect against the threats in a network</p>			
Unit	Topic	No. of lectures	
I	<p>Introduction: Security Trends, The OSI Security Architecture, Security Attacks, Security Services, Security Mechanisms</p> <p>Classical Encryption Techniques: Symmetric Cipher Model, Substitution Techniques, Transposition Techniques, Steganography, Block Cipher Principles, The Data Encryption Standard, The Strength of DES, AES (round details not expected), Multiple Encryption and Triple DES, Block Cipher Modes of Operation, Stream Ciphers</p> <p>Public-Key Cryptography and RSA: Principles of Public-Key Cryptosystems, The RSA Algorithm</p>	15	
II	<p>Key Management: Public-Key Cryptosystems, Key Management, Diffie-Hellman Key Exchange</p> <p>Message Authentication and Hash Functions: Authentication Requirements, Authentication Functions, Message Authentication Codes, Hash Functions, Security of Hash Functions and Macs, Secure Hash Algorithm, HMAC</p>	15	

	<p>Digital Signatures and Authentication: Digital Signatures, Authentication Protocols, Digital Signature Standard</p> <p>Authentication Applications: Kerberos, X.509 Authentication, Public-Key Infrastructure</p>	
III	<p>Electronic Mail Security: Pretty Good Privacy, S/MIME</p> <p>IP Security: Overview, Architecture, Authentication Header, Encapsulating Security Payload, Combining Security Associations, Key Management</p> <p>Web Security: Web Security Considerations, Secure Socket Layer and Transport Layer Security, Secure Electronic Transaction</p> <p>Intrusion: Intruders, Intrusion Techniques, Intrusion Detection</p> <p>Malicious Software: Viruses and Related Threats, Virus Countermeasures, DDOS</p> <p>Firewalls: Firewall Design Principles, Types of Firewalls</p>	15

TextBooks :

1) Cryptography and Network Security: Principles and Practice 5th Edition, William Stallings, Pearson,2010

Additional References:

1) Cryptography and Network Security, Atul Kahate, Tata McGraw-Hill, 2013

2) Cryptography and Network, Behrouz A Fourouzan, Debdeep Mukhopadhyay, 2 nd Edition, TMH,2011

Course Code	Course Title	Credits	Practical/ Tutorials Per Week
VESUCS P502	Information and Network Security Practical	1	3
1	Write programs to implement the following Substitution Cipher Techniques: <ul style="list-style-type: none"> - Caesar Cipher - Monoalphabetic Cipher 		
2	Write programs to implement the following Substitution Cipher Techniques:		

	<ul style="list-style-type: none"> - Vernam Cipher - Playfair Cipher
3	<p>Write programs to implement the following Transposition Cipher Techniques:</p> <ul style="list-style-type: none"> - Rail Fence Cipher - Simple Columnar Technique
4	<p>Write program to encrypt and decrypt strings using</p> <ul style="list-style-type: none"> - DES Algorithm - AES Algorithm
5	<p>Write a program to implement RSA algorithm to perform encryption / decryption of a given string.</p>
6	<p>Write a program to implement the Diffie-Hellman Key Agreement algorithm to generate symmetric keys.</p>
7	<p>Write a program to implement the MD5 algorithm compute the message digest.</p>
8	<p>Write a program to calculate HMAC-SHA1 Signature</p>
9	<p>Write a program to implement SSL. 10</p>
10	<p>Configure Windows Firewall to block:</p> <ul style="list-style-type: none"> - A port - An Program - A website

Course Code	Course Title	Credits	Lectures / Week
VESUCS 505	Architecting of IoT	2	3
<p>About the course: This course will help students to understand how IoT projects can be implemented in the industry</p>			
<p>Course Objectives:</p> <ul style="list-style-type: none"> • Discovering the interconnection and integration of the physical world. • Learners should get knowledge of the architecture of IoT. 			
<p>Learning Outcomes:</p> <ul style="list-style-type: none"> • Learners are able to design & develop IoT Devices. • They should also be aware of the evolving world of M2M Communications and IoT analytics. 			
Unit	Topic	No. of lectures	
I	<p>IoT-An Architectural Overview: Building architecture, Main design principles and needed capabilities, An IoT architecture outline, standards considerations.</p> <p>IoT Architecture-State of the Art : Introduction, State of the art, Reference Model and architecture, IoT reference Model - IoT Reference Architecture Introduction, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views</p>	15	
II	<p>IoT Data Link Layer and Network Layer Protocols:</p> <p>PHY/MAC Layer(3GPP MTC, IEEE 802.11, IEEE 802.15), Wireless HART,Z-Wave, Bluetooth Low Energy, Zigbee Smart Energy DASH7</p> <p>Network Layer:IPv4, IPv6, 6LoWPAN, 6TiSCH,ND, DHCP, ICMP, RPL, CORPL, CARP</p>	15	
III	<p>Transport layer protocols :</p> <p>Transport Layer (TCP, MPTCP, UDP, DCCP, SCTP)-(TLS, DTLS)</p> <p>Session layer:</p> <p>Session Layer-HTTP, CoAP, XMPP, AMQP, MQTT</p> <p>Service layer protocols:</p> <p>Service Layer -oneM2M, ETSI M2M, OMA, BBF</p>	15	

TextBooks :

1. From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence, Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle, 1st Edition, Academic Press, 2014.
2. Learning Internet of Things, Peter Waher, PACKT publishing, BIRMINGHAM – MUMBAI, 2015

Additional References:

1. Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications, Daniel Minoli, Wiley Publications, 2013
2. Internet of Things (A Hands-on Approach), Vijay Madiseti and Arshdeep Bahga, 1st Edition, VPT, 2014.
3. http://www.cse.wustl.edu/~jain/cse570-15/ftp/iot_prot/index.html

Course Code	Course Title	Credits	Practical/Tutorials Per Week
VESUCS P502	Architecting of IoT Practical	1	3
1	<p>a) Edit text files with nano and cat editor, Learn sudo privileges and Unix shell commands such as cd , ls , cat, etc</p> <p>b) Learn to set dynamic and static IP. Connect to and Ethernet and WiFi network. Learn to vnc and ssh into a raspberry pi using vnc and putty from a different computer on the network.</p> <p>c) Write a basic bash script to open programs in kiosk mode. Learn how to autostart programs on boot.</p>		
2	<p>Run the node red editor and run simple programs and trigger gpios.</p> <p>Use basic nodes such as inject, debug, gpio</p>		
3	<p>Open the python idle editor and run simple Python scripts such as to print Fibonacci numbers, string functions. Learn how to install modules using Pip and write functions</p>		
4	<p>Setup a physical button switch and trigger an led in node red and python w</p>		

	debounce
5	Write simple JavaScript functions in Node-Red simple HTTP server page using node red
6	Setup a TCP server and client on a raspberry pi using Python modules to send messages and execute shell commands from within python such as starting another application
7	Trigger a set of led Gpios on the pi via a Python Flask web server
8	Interface the raspberry pi with a 16x2 LCD display and print values.
9	Setup a Mosquitto MQTT server and client and write a Python script to communicate data between Pi's.
10	Interface with an Accelerometer Gyro Mpu6050 on the i2c bus and send sensor values over the internet via mqtt.

Course Code	Course Title	Credits	Lectures / Week
VESUCS506	Web Services	2	3

About the course: This course introduces how web services are designed using various technologies

Course Objectives : The course objectives are as follows -

- To understand the details of web services technologies like SOAP, WSDL, and UDDI. To learn how to implement and deploy web service client and server.
- To understand the design principles and application of SOAP and REST based web services (JAX-WS and JAX-RS). To understand WCF service.
- To design secure web services and QoS of Web Services

Learning Outcomes - The learning outcomes are as follows -

- Emphasis on SOAP based web services and associated standards such as WSDL.
- Design SOAP based / RESTful / WCF services Deal with Security and QoS issues of Web Services

Unit	Topic	No. of lectures
I	Web services basics :What Are Web Services? Types of Web Services Distributed computing infrastructure, overview of XML, SOAP, Building Web Services with JAX-WS, Registering and Discovering Web Services, Service Oriented Architecture, Web Services Development Life Cycle, Developing and consuming simple Web Services across platform	15
II	The REST Architectural style : Introducing HTTP, The core architectural elements of a RESTful system, Description and discovery of RESTful web services, Java tools and frameworks for building RESTful web services, JSON message format and tools and frameworks around JSON, Build RESTful web services with JAX-RS APIs, The Description and Discovery of RESTful Web Services, Design guidelines for building RESTful web services, Secure RESTful web services	15
III	Developing Service-Oriented Applications with WCF : What Is Windows Communication Foundation, Fundamental Windows Communication Foundation Concepts, Windows Communication Foundation Architecture, WCF and .NET Framework Client Profile, Basic WCF Programming, WCF Feature Details. Web Service QoS	15

TextBooks :

- 1) Web Services: Principles and Technology, Michael P. Papazoglou, Pearson Education Limited, 2008
- 2) RESTful Java Web Services, Jobinesh Purushothaman, PACKT Publishing, 2nd Edition, 2015
- 3) Developing Service-Oriented Applications with WCF, Microsoft, 2017 <https://docs.microsoft.com/en-us/dotnet/framework/wcf/index>

Additional References:

- 1) Leonard Richardson and Sam Ruby, RESTful Web Services, O'Reilly, 2007
- 2) The Java EE 6 Tutorial, Oracle, 2013

Course Code	Course Title	Credits	Practical/ Tutorials Per Week

VESUCS P502	Web Services	1	3
1	Write a program to implement to create a simple web service that converts the temperature from Fahrenheit to Celsius and vice versa.		
2	Write a program to implement the operation can receive request and will return a response in two ways. a) One - Way operation b) Request –Response		
3	Write a program to implement business UDDI Registry entry.		
4	Develop client which consumes web services developed in different platform.		
5	Write a JAX-WS web service to perform the following operations. Define a Servlet / JSP that consumes the web service.		
6	Define a web service method that returns the contents of a database in a JSON string. The contents should be displayed in a tabular format.		
7	Define a RESTful web service that accepts the details to be stored in a database and performs CRUD operation.		
8	Implement a typical service and a typical client using WCF.		
9	Use WCF to create a basic ASP.NET Asynchronous JavaScript and XML (AJAX) service.		
10	Demonstrates using the binding attribute of an endpoint element in WCF		

Course Code	Course Title	Credits	Lectures / Week
VESUCS507	Game Programming	2	3
<p>About the Course: Game Programming is the process of creating video games, from concept to final product. It involves a range of disciplines including game design, programming, art and animation, sound design, and quality assurance testing.</p>			
<p>Course Objectives:</p> <ul style="list-style-type: none"> To understand the computer Graphics programming 			

- To understand the Unity Engine newer technologies and programming using most important API for windows.
- To understand the particle system, animation and sound design using unity engine.
- To understand different rendering engine along with the VR and AR.

Learning Outcomes:

Learners should study Graphics and gaming concepts with the present working style of developers where everything remains on the internet and they need to review it, understand it, be a part of community and learn.

Unit	Topic	No. of lectures
I	<p>Mathematics for Computer Graphics - Cartesian Coordinate system, The Cartesian XY-plane, Areas of Shapes, Theorem of Pythagoras in 2D, Coordinates, Theorem of Pythagoras in 3D, 3D Polygons, Euler's Rule</p> <p>Transformations: 2D Transformations, Matrices, Homogeneous Coordinates, 3D Transformations, Change of Axes, Direction Cosines, rotating a Point about an Arbitrary Axis, Transforming Vectors</p> <p>Interpolation: Linear Interpolant, Non-Linear Interpolation, Curves: Circle, Bezier, B-Splines</p> <p>Vectors: Vector Manipulation, multiplying a Vector by a Scalar, Vector Addition and Subtraction, Position Vectors, Unit Vectors, Cartesian Vectors, Vector Multiplication, Scalar Product, Example of the Dot Product, The Dot Product in Lighting Calculations, The Dot Product in Back-Face Detection, The Vector Product, The Right-Hand Rule,</p>	15
II	<p>Unity Engine: Multi-platform publishing, VR + AR: Introduction and working in Unity, 2D, 3D Graphics, Physics, Scripting, Colliders Types.</p> <p>Scripting: Scripting Overview, Scripting Tools and Event Overview</p> <p>Particles: Particle System components and modules Emission, Shape, Velocity over Lifetime, and Force Over Lifetime modules, Particle Collisions and Triggers, Creating custom particle shaders and textures, Importing and using particle assets from the Unity Asset Store</p> <p>Animation: 3D Rigging, Morphing, Skeletal animation, Timeline, Multiplayer and Networking, UI, Navigation and Pathfinding.</p>	15

III	<p>Sound Design: Audio Mixer and Audio Sources components, Sound spatialization and 3D sound positioning, Sound effects and audio clips import and organization, Using audio events to trigger sounds in the game.</p> <p>Introduction to Rendering Engines: Understanding the current market Rendering Engines. Understanding AR, VR and MR. Depth Mappers, Mobile Phones, Smart Glasses, HMD's XR: VR, AR, MR, Conceptual Differences. SDK, Devices</p>	15
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Textbooks:

- 1) Mathematics for Computer Graphics, John Vince, Springer-Verlag London, 5th Edition, 2017
- 2) Mathematics for 3D Game Programming and Computer Graphic, Eric Lengyel, Delmar Cengage Learning, Delmar Cengage Learning, 2011
- 3) <https://docs.unity3d.com/Manual/index.html> - Free

Additional References:

Computer Graphics, C Version, Donald Hern and Pauline Baker, Pearson Education, 2nd Edition, 1997

Course Code	Course Title	Credits	Practical/ Tutorials Per Week
VESUCSP503	Game Programming Practical	1	3
1	Drawing 2D & 3D shapes and performing transformations on them.		
2	Create an environment around representing walls, bricks, ground, sticks etc. The ball should fall using gravity and keep on bouncing randomly as it hits these objects.		
3	Using Unity 2D, Create 2D UFO Game.		
4	Using Unity 2D, Create 2D game for collecting a collectable object and also use TextMeshPro to display count or score on screen.		
5	Using unity 2D, Create 2D game and also add animation on gameObject.		
6	Use Different 3D Primitive game objects and create a game scene along with different light effects.		
7	Using Unity 3D, construct a 3d scene representing any area (such as your college) using basic 3d objects such as cube, sphere, capsule etc. Also use objects like 3d plane, textures (for road, building etc), lights etc.		
8	Using Unity 3D, construct a scene containing a 3d Ball and various objects around it. As the ball rolls, it can hit other objects & both should get affected.		
9	Create a 3D Scene using Textures and Terrain Effect.		

10	Create a 3D/2D game by applying particle system and sound design.
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Course Code	Course Title	Credits	Practical/ Tutorials Per Week
VESUCSP 503	Project Implementation	1	3

Please Refer to Project Implementation Guidelines

Semester 6

Course Code	Course Title	Credits	Lectures / Week
VESUCS6 01	Wireless Sensor Networks and Mobile Communication	2	3

About the Course: In this era of wireless and ad hoc network, connecting different wireless devices and understanding their compatibility is very important. Information is gathered in many different ways from these devices. Learner should be able to conceptualize and understand the framework. On completion, will be able to have a firm grip over this very important segment of wireless network.

Course Objectives: The objectives of the course are -

- Introduce WSN and various components
- Cover various types of protocols used in wireless communication
- To inculcate ability to help learners to design networks for real life problems

Learning Outcomes: After completion of this course -

- learners should be able to list various applications of wireless sensor networks, describe the concepts, protocols, design, implementation and use of wireless sensor networks.
- Implement and evaluate new ideas for solving wireless sensor network design issues.

Unit	Topic	No. of lectures
I	<p>Introduction: Introduction to Sensor Networks, unique constraints and challenges.</p> <p>Advantage of Sensor Networks, Applications of Sensor Networks, Mobile Adhoc NETWORKS (MANETs) and Wireless Sensor Networks, Enabling technologies for Wireless Sensor Networks.</p> <p>Sensor Node Hardware and Network Architecture: Single-node</p>	15

	architecture, Hardware components & design constraints, Operating systems and execution environments, introduction to TinyOS and nesC. Network architecture, Optimization goals and figures of merit, Design principles for WSNs, Service interfaces of WSNs, Gateway concepts.	
II	<p>Medium Access Control Protocols: Fundamentals of MAC Protocols, MAC Protocols for WSNs, Sensor-MAC Case Study.</p> <p>Routing Protocols : Data Dissemination and Gathering, Routing Challenges and Design Issues in Wireless Sensor Networks, Routing Strategies in Wireless Sensor Networks.</p> <p>Transport Control Protocols : Traditional Transport Control Protocols, Transport Protocol Design Issues, Examples of Existing Transport Control Protocols, Performance of Transport Control Protocols.</p>	15
III	<p>Introduction, Wireless Transmission and Medium Access Control:</p> <p>Applications, A short history of wireless communication.</p> <p>Wireless Transmission: Frequency for radio transmission, Signals, Antennas, Signal propagation, Multiplexing, Modulation, Spread spectrum, Cellular systems.</p> <p>Telecommunication, Satellite and Broadcast Systems: GSM: Mobile services, System architecture, Radio interface, Protocols, Localization And Calling, Handover, security, New data services; DECT: System architecture, Protocol architecture; ETRA, UMTS and IMT- 2000.</p> <p>Satellite Systems: History, Applications, Basics: GEO, LEO, MEO; Routing, Localization, Handover.</p>	15
<p>Textbooks:</p> <p>1) Protocols and Architectures for Wireless Sensor Network, Holger Kerl, Andreas Willig, John Wiley and Sons, 2005</p> <p>2) Wireless Sensor Networks Technology, Protocols, and Applications ,Kazem Sohraby, Daniel Minoli and TaiebZnati, John Wiley & Sons, 2007</p>		

3) Mobile communications, Jochen Schiller, 2nd Edition, Addison wisely , Pearson Education, 2012

Additional References:

1) Fundamentals of Wireless Sensor Networks, Theory and Practice, Waltenequs Dargie, Christian Poellabauer , Wiley Series on wireless Communication and Mobile Computing, 2011

2) Networking Wireless Sensors, Bhaskar Krishnamachari , Cambridge University Press, 2005

Course Code	Course Title	Credits	Practical/ Tutorials Per Week
VESUCS P601	Wireless Sensor Networks and Mobile Communication Practical	1	3
1	Understanding the Sensor Node Hardware. (For Eg. Sensors, Nodes(Sensor mote), Base Station, Graphical User Interface.)		
2	Exploring and understanding TinyOS computational concepts:- Events, Commands and Task. - nesC model - nesC Components		
3	Understanding TOSSIM for - Mote-mote radio communication - Mote-PC serial communication		
4	Create and simulate a simple adhoc network		
5	Understanding, Reading and Analyzing Routing Table of a network.		
6	Create a basic MANET implementation simulation for Packet animation and Packet Trace.		
7	Implement a Wireless sensor network simulation		

8	Create MAC protocol simulation implementation for wireless sensor Network.
9	Simulate Mobile Adhoc Network with Directional Antenna
10	Create a mobile network using Cell Tower, Central Office Server, Web browser and Web Server. Simulate connection between them.
<i>Practical experiments require software tools like INET Framework for OMNeT++, NetSim , TOSSIM, Cisco packet tracer 6.0 and higher version.</i>	

Course Code	Course Title	Credits	Lectures / Week
VESUCS602	Cloud Computing	2	3
<p>About the Course: To provide learners with the comprehensive and in-depth knowledge of Cloud Computing concepts, technologies, architecture, implantations and applications. To expose the learners to frontier areas of Cloud Computing, while providing sufficient foundations to enable further study and research.</p>			
<p>Course Objectives:</p> <ol style="list-style-type: none"> 1. To acquire knowledge about cloud computing and its architecture. 2. To understand services of cloud computing and Types of cloud 3. Introducing students about virtualization and hypervisors 4. Study the concept of openstack. 			
<p>Learning Outcomes: After successfully completion of this course -</p> <ul style="list-style-type: none"> • The learner should be able to articulate the main concepts, key technologies, strengths, and limitations of cloud computing and the possible applications for state-of-the-art cloud computing using open source technology. • Learner should be able to identify the architecture and infrastructure of cloud computing, including SaaS, PaaS, IaaS, public cloud, private cloud, hybrid cloud, etc. • They should explain the core issues of cloud computing such as security, privacy, and interoperability. 			
Unit	Topic	No. of lectures	
I	Introduction to Cloud Computing, Characteristics and benefits of Cloud Computing, Basic concepts of Distributed Systems, Web 2.0, Service-Oriented Computing, Utility-Oriented Computing. Elements of Parallel Computing. Elements of Distributed Computing. Technologies for Distributed Computing. Cloud Computing Architecture. The cloud reference model. Infrastructure as a service. Platform as a service. Software as a service. Types of clouds.	15	

II	<p>Characteristics of Virtualized Environments. Taxonomy of Virtualization Techniques. Virtualization and Cloud Computing. Pros and Cons of Virtualization. Virtualization using KVM, Creating virtual machines, oVirt - management tool for virtualization environment. Open challenges of Cloud Computing</p> <p>Cloud Platforms and Cloud Applications Microsoft Cloud Services: Azure core concepts, SQL Azure, Windows Azure Platform Appliance, Amazon Web Services (AWS): Amazon Web Services and Components, Amazon Simple DB, Elastic Cloud Computing (EC2), Amazon Storage System, Amazon Database services (Dynamo DB).</p>	15
III	<p>Introduction to OpenStack, OpenStack test-drive, Basic OpenStack operations, OpenStack CLI and APIs, Tenant model operations, Quotas, Private cloud building blocks, Controller deployment, Networking deployment, Block Storage deployment, Compute deployment, deploying and utilizing OpenStack in production environments, Building a production environment, Application orchestration using OpenStack Heat</p>	15

TextBooks :

- 1) Mastering Cloud Computing, Rajkumar Buyya, Christian Vecchiola, S Thamarai Selvi, Tata McGraw Hill Education Private Limited, 2013
- 2) OpenStack in Action, V. K. CODY BUMGARDNER, Manning Publications Co, 2016

Additional Reference(s):

- 1) OpenStack Essentials, Dan Radez, PACKT Publishing, 2015
- 2) OpenStack Operations Guide, Tom Fifield, Diane Fleming, Anne Gentle, Lorin Hochstein, Jonathan Proulx, Everett Toews, and Joe Topjian, O'Reilly Media, Inc., 2014
- 3) <https://www.openstack.org>

Course Code	Course Title	Credits	Practical/ Tutorials Per Week
VESUCS P601	Cloud Computing Practical	1	3
1	Study of Cloud Computing & Architecture		
2	Study and implementation of Infrastructure as a Service.		
3	Study and implementation of Storage as a Service		
4	Study and implementation of azure sql Database.		
5	User Management in Cloud.(create user,group)		

6	Study Cloud Security management
7	Study and Implementation of custom domain
8	Write a program for web feed.
9	Case study on Amazon EC2/Microsoft Azure/Google Cloud Platform

Course Code	Course Title	Credits	Lectures / Week
VESUCS603	Blockchain Technology	2	3

About the Course:

This course provides a broad overview of the essential concepts of blockchain technology – by initially exploring the Bitcoin protocol followed by the Ethereum protocol – to lay the foundation necessary for developing applications and programming.

Course Objectives:

- To understand the history, types and applications of Blockchain
- To acquire knowledge about cryptography and consensus algorithms.
- Deploy projects using python, solidity and design blockchain based applications.

Learning Outcomes:

- Explain blockchain technology as a security mechanism
- Explore blockchain types and implementation
- Construct and deploy Smart contracts using Ethereum
- Implement decentralized applications using blockchain in real-time applications.
- Describe Private Blockchain using Hyperledger Fabric

Unit	Topic	No. of lectures
I	<p>History: Traditional financial arrangements, The trouble with credit cards online, From Credit to (Crypto) Cash.</p> <p>Introduction to Cryptography & Cryptocurrencies: Cryptographic Hash Functions, Hash Pointers and Data Structures, Digital Signatures, Public Keys as Identities. Centralization vs. Decentralization, Distributed consensus.</p> <p>Bitcoin Cryptocurrency Introduction to Bitcoin, Bitcoin users - Full Client, Light Client, Web Client. Implicit Consensus, Bitcoin consensus algorithm, Stealing Bitcoins,.</p>	15

<p>II</p>	<p>Validation Algorithms: Proof of work, Proof of Stake, Proof of Authority, Proof of Activity, Proof of Burn, Proof of Capacity. Block Reward, Transaction fees, Bitcoin transactions, Bitcoin Scripts, Bitcoin blocks, Bitcoin network, Alternative coins, Bitcoins, namecoin, Peercoin. Bitcoin Security-Security principles,</p> <p>Objective of Blockchain: Blockchain Challenges, Transactions And Blocks, P2P Systems, Keys As Identity, Digital Signatures, Hashing, and public key cryptosystems, private vs. public Blockchain. Transactional Blocks, Impact Of Blockchain Technology On Cryptocurrency.</p> <p>Bitcoin Mining- The task of Bitcoin miners, Mining Hardware-CPU mining, GPU mining, FPGA mining, ASIC mining</p>	<p>15</p>
<p>III</p>	<p>Introduction to Ethereum: What is Ethereum, Introduction to Ethereum, Consensus Mechanisms, Ethereum Programming Language – Solidity, Mining in Ethereum, uses and benefits of Ethereum, Introduction to Ethereum Development Tools, Ethereum Clients, Ethereum Languages, Ethereum Wallets, Ethereum Accounts, Ethereum Keypairs, Ethereum Platform.</p> <p>Solidity Programming: Solidity - Language of Smart Contracts, Installing Solidity & Ethereum Wallet, Basics of Solidity, Layout of a Solidity Source File & Structure of Smart Contracts, General Value Types (Int, Real, String, Bytes, Arrays, Mapping, Enum, address)</p> <p>Introduction to Hyperledger: What is Hyperledger? Distributed Ledger Technology & its Challenges, Hyperledger & Distributed Ledger Technology, Hyperledger architecture, Consensus in Hyperledger, Hyperledger frameworks, Hyperledger Fabric.</p>	<p>15</p>
<p>Textbooks:</p> <ol style="list-style-type: none"> 1. Mastering Blockchain, Imran Bashir, packt. 2. A Practical Guide to Developing Business, Law, and Technology Solutions, Joseph J. Bambara Paul R. Allen. 3. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller and Steven Goldfeder, Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction, Princeton University Press (July 19, 2016). <p>Additional References:</p> <ol style="list-style-type: none"> 1. https://www.blockchainexpert.uk/book/blockchain-book.pdf 2. Mastering Bitcoin by Andreas M. Antonopoulos, O'Reilly. 3. Mastering Ethereum, Andreas M. Antonopoulos, O'Reilly 		

Course Code	Course Title	Credits	Practical/ Tutorials Per Week
VESUCS P601	Blockchain Technology Practical	1	3
1	Basic demonstration of blockchain technology		
2	Demonstrate Solidity programming of simple smart contract		
3	Install Ganache blockchain test network and deploy solidity smart contract		
4	Demonstrate setup of myEtherWallet and connect it to Ganache Network		
5	Demonstrate geth client to create genesis block on your own block chain		
6	Demonstrate the blockchain in Python		
7	Demonstrate Cryptocurrency		
8	Blockchain explorer for Bitcoin and Ethereum- Study and understand the various statistics observations related to bitcoin and Ethereum cryptocurrencies		
9	Build Hyperledger Fabric with Smart Contract.		
10	Install and Get Started with the Bitcoin core client. Write a program to get Bitcoin and create transactions.		

Course Code	Course Title	Credits	Lectures / Week
VESUCS 604	Information Retrieval	2	3

Information retrieval (IR) is the process of obtaining information resources relevant to an information need from a collection of information resources. IR typically employs one or more of the following techniques:

- text indexing and searching
- natural language processing (NLP) and
- Machine Learning etc.

IR systems are used in a variety of applications, including web search engines, enterprise search, and digital libraries.

Course Objectives

1. Developing an understanding of the fundamental concepts and techniques used in information

retrieval, such as indexing, retrieval models, and evaluation.

2. Familiarizing students with various types of information retrieval systems, including text retrieval, image retrieval, and video retrieval.
3. Teaching students how to design, implement, and evaluate information retrieval systems.
4. Introducing students to recent research and developments in the field of information retrieval.
5. Providing students with the ability to apply information retrieval techniques to real-world problems and datasets.

Learning Outcomes

1. The ability to understand and describe the basic concepts, models, and algorithms used in information retrieval.
2. The ability to design and implement information retrieval systems, including text retrieval, image retrieval, and video retrieval.
3. The ability to evaluate information retrieval systems using appropriate metrics and techniques.
4. The ability to apply information retrieval techniques to real-world problems and datasets.
5. The ability to conduct literature reviews and stay current with recent research and developments in the field.
6. The ability to analyze and solve information retrieval problems using a variety of techniques.

Unit	Topic	No. of lectures
I	<p>Introduction to Information Retrieval: Introduction, History of IR, Components of IR, and Issues related to IR, Boolean retrieval, Dictionaries, and tolerant retrieval. Vector space model - Parametric and zone indexes, Term frequency and weighting, The vector space model for scoring Techniques. Sentiment Analysis and Opinion Mining. Sentiment analysis: determining the overall sentiment (positive, negative, neutral) of a given piece of text. Text classification: assigning a label or category to a piece of text based on its content. Natural Language Processing (NLP) techniques, such as tokenization, stemming, lemmatization, and part-of-speech tagging. Text-based Information Retrieval techniques and evaluation metrics. Applications of text analytics in areas such as social media analytics, customer service, and fraud detection.</p>	15
II	<p>Index Construction, Compression & Specialized Search:, Index Construction & Compression, Personalized search, Collaborative filtering and content-based recommendation of documents and products.</p> <p>Handling “invisible” Web, Snippet generation, Summarization,</p>	15

	Question Answering, Cross- Lingual Retrieval.	
III	Web Search Engine Crawlers and Link Analysis: Link Analysis, hubs and authorities, Pagerank and HITS algorithms Web Search Engine: Web search overview, web structure, the user, paid placement, search engine optimization/spam, Web size measurement, search engine optimization/spam, Web Search Architectures Web crawling and indexes. Introduction to web analytics and the importance of data collection and analysis in website design and development. Techniques for collecting web data, including web server logs, cookies, and web analytics tools such as Google Analytics. Methods for analyzing web data, including descriptive statistics, data visualization, and data mining.	15

TextBooks : Blue added newly,green made changes

- 1) Introduction to Information Retrieval, C. Manning, P. Raghavan, and H. Schütze, Cambridge University Press, 2008
- 2) Modern Information Retrieval: The Concepts and Technology behind Search, Ricardo Baeza -Yates and Berthier Ribeiro – Neto, 2nd Edition, ACM Press Books 2011.

Additional References:

- 1) Search Engines: Information Retrieval in Practice, Bruce Croft, Donald Metzler and Trevor Strohman, 1st Edition, Pearson, 2009.
2. Information Retrieval : Madhavi Vaidya, Wiley Publications.

Course Code	Course Title	Credits	Practical/ Tutorials Per Week
VESUCS P602	Information Retrieval Practical	1	3
1	Write a program to implement an incidence matrix and evaluate query.		
2	Implement Page Rank Algorithm.		
3	Implement Dynamic programming algorithm for computing the edit distance between strings s1 and s2. (Hint. Levenshtein Distance)		

4	Write a program to Compute Similarity between two text documents.
5	Write a program for Pre-processing of a Text Document: stop word removal.
6	Write a program on Text Summarization.
7	Write a program for mining any social networking site's data.
8	Write a program to implement simple web crawler along with finding the number of links on the current web page using web analytics
9	Implement Porter Stemmer.

Course Code	Course Title	Credits	Lectures / Week
VESUCS605	Digital Image Processing	2	3

About the Course: This course enables learners to understand how image data can be processed as signals and how various filters can be applied on them

Course Objectives:

- To study two-dimensional Signals and Systems.
- To understand image fundamentals and transforms necessary for image processing.
- To study the image enhancement techniques in spatial and frequency domain.
- To study image segmentation and image compression techniques.

Learning Outcomes: After the completion of the course, the learner -

- should be able to review the fundamental concepts of a digital image processing system.
- Should be able to analyze the images in the frequency domain using various transforms.
- Should be evaluate the techniques for image enhancement and image segmentation.
- Apply various compression techniques. They will be familiar with basic image processing techniques for solving real problems.

Unit	Topic	No. of lectures
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<p>I</p>	<p>Introduction to Image-processing System : Introduction, Image Sampling, Quantization, Resolution, Human Visual Systems, Elements of an Image-processing System, Applications of Digital Image Processing</p> <p>2D Signals and Systems : 2D signals, separable sequence, periodic sequence, 2D systems, classification of 2D systems, 2D Digital filter</p> <p>Convolution and Correlation : 2D Convolution through graphical method, Convolution through 2D Z—transform, 2D Convolution through matrix analysis, Circular Convolution, Applications of Circular Convolution, 2D Correlation</p> <p>Image Transforms: Need for transform, image transforms, Fourier transform, 2D Discrete Fourier Transform, Properties of 2D DFT, Importance of Phase, Walsh transform, Hadamard transform, Haar transform, Slant transform, Discrete Cosine transform, KL transform</p>	<p>15</p>
<p>II</p>	<p>Image Enhancement :Image Enhancement in spatial domain, Enhancement through Point operations, Histogram manipulation, Linear and nonlinear Gray Level Transformation, local or neighborhood operation, Median Filter, Spatial domain High pass filtering, Bit-plane slicing, Image Enhancement in frequency domain, Homomorphic filter, Zooming operation, Image Arithmetic</p> <p>Binary Image processing :Mathematical morphology, Structuring elements, Morphological image processing, Logical operations, Morphological operations, Dilation and Erosion, Distance Transform</p> <p>Colour Image processing :Colour images, Colour Model, Colour image quantization, Histogram of a colour image</p>	<p>15</p>
<p>III</p>	<p>Image Segmentation: Image segmentation techniques, Region approach, Clustering techniques, Thresholding, Edge-based segmentation, Edge detection, Edge Linking, Hough Transform</p> <p>Image Compression: Need for image compression, Redundancy in images, Image-compression scheme, Fundamentals of Information Theory, Run-length coding, Shannon-Fano coding, Huffman Coding, Arithmetic Coding, Transform-based compression, Image-compression standard</p>	<p>15</p>

Textbooks:

- 1) Digital Image Processing, S Jayaraman, S Esakkirajan, T Veerakumar, Tata McGraw-Hill

Education Pvt. Ltd., 2009

Additional References:

- 1) Digital Image Processing 3rd Edition, Rafael C Gonzalez, Richard E Woods, Pearson, 2008
- 2) Scilab Textbook Companion for Digital Image Processing, S. Jayaraman, S. Esakkirajan And T. Veerakumar, 2016
(https://scilab.in/textbook_companion/generate_book/125)

Course Code	Course Title	Credits	Practical/Tutorials Per Week
VESUCS P602	Digital Image Processing Practical	1	3
1	2D Linear Convolution, Circular Convolution between two 2D matrices		
2	Circular Convolution expressed as linear convolution plus alias		
3	Linear Cross correlation of a 2D matrix, Circular correlation between two signals and Linear autocorrelation of a 2D matrix, Linear Cross correlation of a 2D matrix		
4	DFT of 4x4 gray scale image		
5	Compute discrete cosine transform, Program to perform KL transform for the given 2D matrix		
6	Brightness enhancement of an image, Contrast Manipulation, image negative		
7	Perform threshold operation, perform gray level slicing without background		
8	Image Segmentation		
9	Image Compression		
10	Binary Image Processing and Colour Image processing		

Practical need to be performed using Scilab under Linux or Windows

Course Code	Course Title	Credits	Lectures / Week
VESUCS 606	Artificial Intelligence	2	3
<p>About the course: Artificial Intelligence (AI) and accompanying tools and techniques bring transformational changes in the world. Machines capability to match, and sometimes even surpass human capability, make AI a hot topic in Computer Science. This course aims to introduce the learner to this interesting area.</p>			
<p>Course Objectives: The objectives of the course are as follows -</p> <ul style="list-style-type: none"> • Introduce the core concepts of AI • Cover various searching algorithms for problem solving • Introduce concepts of knowledge representation • To cover various machine learning algorithms 			
<p>Learning Outcomes: After completion of this course, learner should -</p> <ul style="list-style-type: none"> • get a clear understanding of AI and different search algorithms used for solving problems. • get acquainted with different learning algorithms and models used in machine learning. 			
Unit	Topic	No. of lectures	
I	What Is AI: Foundations, History and State of the Art of AI. Intelligent Agents: Agents and Environments, Nature of Environments, Structure of Agents. Problem Solving by searching: Problem-Solving Agents, Uninformed Search Strategies, Informed (Heuristic) Search Strategies,	15	
II	Knowledge Representation and different forms, Reasoning, Planning, Uncertainty in Knowledge, Fuzzy Logic & Fuzzification Machine Learning, Forms of Learning, Parametric & Non-Parametric Models, Classification , Regression, Regularization, Decision Trees, SVM, Artificial Neural Networks, Ensemble Learning, Boosting, K-NN, Gradient Descenet	15	
III	Probabilistic models: Statistical Learning, Learning with Complete Data, Naive Bayes Classifier, Learning with Hidden Variables: The EM Algorithm Unsupervised Learning - Concept of Unsupervised learning,, Association Rule Mining, Reinforcement learning: Concept of Reinforcement learning, Q-Learning, Hidden Markov Model	15	
<p>TextBooks : 1) Artificial Intelligence: A Modern Approach, Stuart Russell and Peter Norvig,3rd Edition, Pearson, 2010.</p> <p>Additional References: 1) Artificial Intelligence: Foundations of Computational Agents, David L Poole,Alan K. Mackworth, 2nd Edition, Cambridge University Press ,2017. 2) Artificial Intelligence, Kevin Knight and Elaine Rich, 3rd Edition, 2017 3) The Elements of Statistical Learning, Trevor Hastie, Robert Tibshirani and Jerome Friedman, Springer, 2013</p>			

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Course Code	Course Title	Credits	Practical/ Tutorials Per Week
VESUCS P602	Artificial Intelligence	1	3
1	Implement Breadth first search & Iterative depth first search algorithm		
2	Implement A* search and recursive best-first search algorithm		
3	Implement decision tree learning algorithm		
4	Implement feed forward back propagation neural network learning algorithm		
5	Implement SVM Algorithm		
6	Implement Adaboost ensemble learning algorithm		
7	Implement Naive Bayes' learning algorithm		
8	Implement K-NN Algorithm		
9	Implement Association rule mining algorithm		
10	Demo of OpenAI / TensorFlow tools		

Course Code	Course Title	Credits	Lectures / Week
VESUCS6 07	Ethical Hacking	2	3

About the Course:

Ethical hacking plays an important role in improving the security of computer systems and networks, and is an increasingly important field as organizations seek to protect themselves from the growing threat of cyber attacks.

Course Objectives:

To understand the ethics, legality, methodologies and techniques of hacking

Learning Outcomes:

Learners will know to identify security vulnerabilities and weaknesses in the target applications. They will also know to test and exploit systems using various tools and understand the impact of hacking in real time machines.

Unit	Topic	No. of lectures
I	<p>Information Security : Attacks and Vulnerabilities</p> <p>Introduction to information security : Asset, Access Control, CIA, Authentication, Authorization, Risk, Threat, Vulnerability, Attack, Attack Surface, Malware, Security-Functionality-Ease of Use Triangle</p> <p>Types of malware : Worms, Viruses, Trojans, Spyware, Rootkits, Ransomware</p> <p>Types of vulnerabilities : OWASP Top 10 : cross-site scripting (XSS), cross site request forgery (CSRF/XSRF), SQL injection, input parameter manipulation, broken authentication, sensitive information disclosure, XML External Entities, Broken access control, Security Misconfiguration, Using components with known vulnerabilities, Insufficient Logging and monitoring, Local and Remote File Inclusion OWASP Mobile Top 10, CVE Database, CWE</p> <p>Types of attacks and their common prevention mechanisms : Keystroke Logging, Denial of Service (DoS /DDoS), Waterhole attack, brute force, phishing and fake WAP, Eavesdropping, Man-in-the-middle, Session Hijacking, Clickjacking, Cookie Theft, URL Obfuscation, buffer overflow, DNS poisoning, ARP poisoning, Identity Theft, IoT Attacks, BOTs and BOTNETs</p> <p>Case-studies : Recent attacks – Yahoo, Adult Friend Finder, eBay, Equifax, WannaCry, Target Stores, Uber, JP Morgan Chase, Bad Rabbit, Follia Vulnerability, Log4J, Solarwind, Spring4Shell</p>	15
II	<p>Ethical Hacking – I (Introduction and pre-attack)</p> <p>Introduction: Black Hat vs. Gray Hat vs. White Hat (Ethical) hacking, Why is Ethical hacking needed?, How is Ethical hacking different from security auditing and digital forensics?, Signing NDA, Compliance and Regulatory concerns, Black box vs. White box vs. Black box, Vulnerability assessment and Penetration Testing.</p> <p>Approach : Planning - Threat Modeling, set up security verification standards, Set up security testing plan – When, which systems/apps, understanding functionality, black/gray/white, authenticated vs. unauthenticated, internal vs. external PT, Information gathering, Perform Manual and automated (Tools: WebInspect/Qualys, Nessus, Proxies, Metasploit) VA and PT, How WebInspect/Qualys tools work: Crawling/Spidering, requests forging, pattern matching to known vulnerability database and Analyzing results, Preparing report, Fixing security gaps following the report</p> <p>Enterprise strategy : Repeated PT, approval by security testing team, Continuous Application Security Testing,</p> <p>Phases: Reconnaissance/foot-printing/Enumeration, Phases: Scanning, Sniffing</p>	15
III	<p>Ethical Hacking :Enterprise Security Phases : Gaining and Maintaining Access : Systems hacking – Windows and Linux – Metasploit and Kali Linux, Keylogging, Buffer Overflows, Privilege Escalation, Network hacking - ARP Poisoning, Password Cracking, WEP Vulnerabilities, MAC Spoofing, MAC Flooding, IPSpoofing, SYN Flooding, Smurf attack,</p>	15

	<p>Applications hacking : SMTP/Email-based attacks, VOIP vulnerabilities, Directory traversal, Input Manipulation, Brute force attack, Unsecured login mechanisms, SQL injection, XSS, Mobile apps security,</p> <p>Malware analysis : Netcat Trojan, wrapping definition, reverse engineering</p> <p>Phases : Covering your tracks : Steganography, Event Logs alteration</p> <p>Additional Security Mechanisms : IDS/IPS, Honeypots and evasion techniques, Secure Code Reviews (Fortify tool, OWASP Secure Coding Guidelines)</p>	
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Textbooks:

- 1) Certified Ethical Hacker Study Guide v9, Sean-Philip Oriyano, Sybex; Study Guide Edition,2016.
- 2) CEH official Certified Ethical Hacking Review Guide, Wiley India Edition, 2007.

Additional References:

- 1) Certified Ethical Hacker: Michael Gregg, Pearson Education, 1st Edition, 2013
- 2) Certified Ethical Hacker: Matt Walker, TMH,2011
- 3) http://www.pentest-standard.org/index.php/PTES_Technical_Guidelines
- 4) https://www.owasp.org/index.php/Category:OWASP_Top_Ten_2017_Project
- 5) https://www.owasp.org/index.php/Mobile_Top_10_2016-Top_10
- 6) https://www.owasp.org/index.php/OWASP_Testing_Guide_v4_Table_of_Contents
- 7) https://www.owasp.org/index.php/OWASP_Secure_Coding_Practices_-_Quick_Reference_Guide
- 8) <https://cve.mitre.org/>
- 9) <https://access.redhat.com/blogs/766093/posts/2914051>
- 10) <http://resources.infosecinstitute.com/applications-threat-modeling/#gref>
- 11) <http://www.vulnerabilityassessment.co.uk/Penetration%20Test.htm>

Course Code	Course Title	Credits	Practical/Tutorials Per Week
VESUCS P603	Ethical Hacking Practical	1	3
1	Use Google and Whois for Reconnaissance		
2	a) Use CrypTool to encrypt and decrypt passwords using RC4 algorithm b) Use Cain and Abel for cracking Windows account password using Dictionary attack and to decode wireless network passwords		
3	a) Run and analyze the output of following commands in Linux – ifconfig, ping, netstat, traceroute b) Perform ARP Poisoning in Windows		
4	Use NMap scanner to perform port scanning of various forms – ACK, SYN, FIN, NULL, XMAS		
5	a) Use Wireshark (Sniffer) to capture network traffic and analyze b) Use Nemesy to launch DoS attack		

6	Simulate persistent cross-site scripting attack
7	Session impersonation using Firefox and Tamper Data add-on
8	Perform SQL injection attack
9	Create a simple keylogger using python
10	Using Metasploit to exploit (Kali Linux)

Course Code	Course Title	Credits	Practical/ Tutorials Per Week
VESUCSP 607	Project Implementation	1	3
Please Refer to Project Implementation Guidelines			

Modality of assessment

The performance of the learners shall be evaluated into two parts. The learner's performance shall be assessed by Internal Assessment with 25% marks in the first part & by conducting the Semester End Examinations with 75% marks in the second part. Practical Examination will consist of End Sem examination.

Students will have to score 40% of marks separately in each of the Internal Theory , External Theory as well as External Practical Examination to pass the course.

I. Internal Evaluation for Theory Courses – 25 Marks

(i) Mid-Term Class Test – 15 Marks

It should be conducted using any learning management system such as Moodle (Modular object-oriented dynamic learning environment)

The test should have 15 MCQ's which should be solved in a time duration of 20 minutes.

(ii) Assignment / Presentations – 10 Marks

Assignment - Any subject-related work in soft copy format comprising of case study, solutions to multiple problems, study and review of published research paper from a reputed journal, technical paper written as white paper

Presentation - Any subject-related work(can be done in a group) comprising of mini-project , explaining topics beyond syllabus, converting any subject-related topic into innovative way

Proof of the assignment/presentation should be maintained.

II. External Examination for Theory Courses – 75 Marks

Duration: 2.5 Hours

Theory question paper pattern:

All questions are compulsory.			
Question	Based on	Options	Marks
Q.1	Unit I	<i>Any 4 out of 6</i>	20
Q.2	Unit II	<i>Any 4 out of 6</i>	20
Q.3	Unit III	<i>Any 4 out of 6</i>	20
Q.4	Unit I,II and III	<i>Any 5 out of 6</i>	15

All questions shall be compulsory with internal choice within the questions. Each Question may be subdivided into sub questions as a, b, c, d, etc. & the allocation of Marks depends on the weightage of the topic.

III. Practical Examination

a) Practical

Each core subject carries 50 Marks

40 marks + 05 marks (journal) + 05 marks (viva)

Duration: 3 Hours for a group practical course / 2 hours for a single practical paper

Minimum 80% practical from each core subjects are required to be completed. Certified Journal is compulsory for appearing at the time of Practical Exam failing which the student will not be allowed to appear for the practical examination. The final submission and evaluation of a journal in electronic form using a Learning Management System / Platform can be promoted.

b) Project Implementation

Evaluation scheme -

Presentation	Working	Quality	Timely Completion	Documentation	Total Marks
10	10	15	05	10	50

Elective I - 100 Marks

Elective II - 100 Marks

Skill Enhancement Practical - 50 Marks

Project Implementation - 50 marks

